Visual Field Defects and the Size and Shape of Pituitary Adenomas

AUTHOR(S):

KOJIMA, MASAYUKI; HANDA, HAJIME; HASHIMOTO, NOBUO; YAMAGAMI, TATSUHITO

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Masayuki Kojima, Hajime Handa, Nobuo Hashimoto, and Tatsuhito Yamagami

Department of Neurosurgery, Faculty of Medicine, Kyoto University
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Abstract

Forty-six cases of pituitary adenoma were studied with CT scan. The patterns of visual field defects were well correlated to the size and shape of adenomas. Sixteen of 17 patients with bitemporal hemianopsia had a mass larger than 20 mm in height from the upper surface of the anterior clinoid process to the tumor summit. Most patients with a huge mass with irregular margin showed atypical field defect. Unilateral field defect was frequently found in cases with irregular shaped mass less than 20 mm in height. None of 15 patients with normal visual field had a mass larger than 20 mm in height.

Introduction

Endocrinological and neuroradiological advancements have made it possible to detect microadenomas in pituitary gland[2,6,8,18,19]. And most interest concerning to pituitary adenomas is now focussed on functioning microadenomas[7,13]. But still a considerable number of patients are diagnosed after deterioration of visual acuity and/or visual field narrowing[4]. This is true not only in cases with non-functioning pituitary adenomas but also in cases with functioning adenomas.

Before the era of CT scan, the pattern of visual field defects was an important indicator of suprasellar extension of the adenoma. But now high resolution CT scan with coronal section has made it possible to visualize the size and shape of the adenoma clearly.

This time we studied the relationship between the size and shape of adenomas and visual disturbances once again using high resolution CT scan.

Clinical materials and methods

We reviewed the medical records of 46 patients harboring pituitary adenoma, who were treated in Kyoto University between July 1979, when high resolution CT scan with coronal sections was available, and October 1983. Cases with microadenoma or intraseller adenoma were

Key words: Computerized tomography, Pituitary adenoma, Visual field defect, Tuberculum sellae meningioma.
索引語：コンピューター断層撮影，下垂体腺腫，視野狭窄，鞍結節部髄膜腫.
Present address: Department of Neurosurgery, Kyoto University Hospital, Sakyo-ku, Kyoto, 606, Japan.

excluded in the present study.

Twenty-two men and 24 women were included with the mean age of 43-year-old. Twenty-seven cases were non-functioning adenomas, 10 cases were growth hormone secreting adenomas, 8 cases were prolactin secreting adenomas, and 1 case was follicle stimulating hormone secreting adenoma.

In all cases, CT scan was performed with coronal sections after contrast medium administration using GE CT/T 8800. Coronal sections were taken parallel to the vertical line of orbitomeatal line with 2 mm intervals, but when the patient's teeth gave rise to artifacts, slices avoiding artifacts were selected.

The width of the adenoma was defined as the maximal horizontal diameter and the height of it as the distance from the upper surface of the anterior clinoid process to the summit of adenoma in a slice including anterior clinoid processes.

Perimetric data of each patient obtained preoperatively by ophthalmologists were used for analysis. The patterns of visual field defects were compared to the size and shape of adenomas.

Medical records of 6 patients with tuberculum sellae meningioma were also reviewed compared with cases with pituitary adenoma.

Results

a) Visual field defects

The patients were divided into four groups according to the patterns of visual field defects. They were bitemporal hemianopsia (BTH), unilateral visual field defect (UFD), atypical visual field defect (AFD), such as homonymous hemianopsia, concentric constriction of visual field and unilateral blindness with temporal hemianopsia of the other eye, and normal visual field. Typical bitemporal hemianopsia was seen in 17 patients (37%), unilateral visual field defect in 8 patients (18%), and atypical visual field defect in 6 patients (13%). Fifteen patients (31%) showed normal visual field.

b) The relationship between width and height of adenomas and the patterns of visual field defects

The mean value of the height of adenomas (the distance from the uppers urface of the anterior clinoid process to the tumor summit) was 22 ± 4 mm in the group of bitemporal hemianopsia (Fig. 1), 15 ± 5 mm in the group of unilateral visual field defect (Fig. 2), 32 ± 12 mm in the group of atypical visual field defect (Fig. 3), and 11 ± 5 mm in the group of normal visual field (Fig. 4). All but one cases of 17 patients in the group of bitemporal hemianopsia had a large mass more than 20 mm in height, one of 8 patients in the group of unilateral visual field defect, 5 of 6 patients in the group of atypical visual field defect, and none of 15 patients with normal visual field (Table 1).

In the group of atypical visual field defect, 3 of 6 patients had a huge adenoma in which height was more than 40 mm. These adenomas were much larger than those in other groups. Cases with huge adenoma showed homonymous hemianopsia or concentric constriction of visual

Fig. 1. Case 11: (Non-functioning pituitary adenoma)
A 28-year-old man with typical bitemporal hemianopsia. CT scan demonstrated a global mass with smooth margin in the sellar and suprasellar region, in which the height was 22 mm.

Fig. 2. Case 19: (Non-functioning pituitary adenoma)
A 54-year-old woman with unilateral visual field defect. The adenoma was not balloon-like but asymmetrical shaped. The height was 18 mm.

Fig. 3. Case 28: (Non-functioning pituitary adenoma)
A 64-year-old woman with concentric constriction of visual fields. A huge mass with irregular margin was 56 mm in width and 44 mm in height.

field (Fig. 3).

The mean value of the width of adenomas was 28±6 mm in the group of bitemporal hemianopsia, 23±9 mm in the group of unilateral visual field defect, 39±12 mm in the group of atypical visual field defect, and 26±7 mm in the group of normal visual field. Concerning to the width of adenomas, no significant difference was found between these groups except the group of atypical visual field defect (Table 1).

c) The relationship between tumor shape of adenomas and the patterns of visual field defects

Table 1. The Relationship between the Patterns of Visual Field Defect and the Size and Shape of Adenomas

Group	No. of Cases	Height* (mm)	Width* (mm)	No. of Cases with Height≧20 mm	No. of Cases of Irregular Shaped Adenomas
BTH	17/46 (37%)	22±4	28±5	16/17 (94%)	2/16 (12%)
UFD	8/46 (18%)	15±5	23±9	1/ 8 (13%)	3/ 8 (37%)
AFD	6/46 (13%)	32±12	39±12	5/ 6 (83%)	6/ 6(100%)
NVF	15/46 (31%)	11±5	26±7	0/15 (0%)	4/15 (27%)

*: Mean±S.D.
BTH : Bitemporal hemianopsia
UFD : Unilateral visual field defect
AFD : Atypical visual field defect
NVF : Normal visual field
Height: The distance from the upper surface of the anterior clinoid process to the summit of the tumor
Width: The maximal horizontal diameter

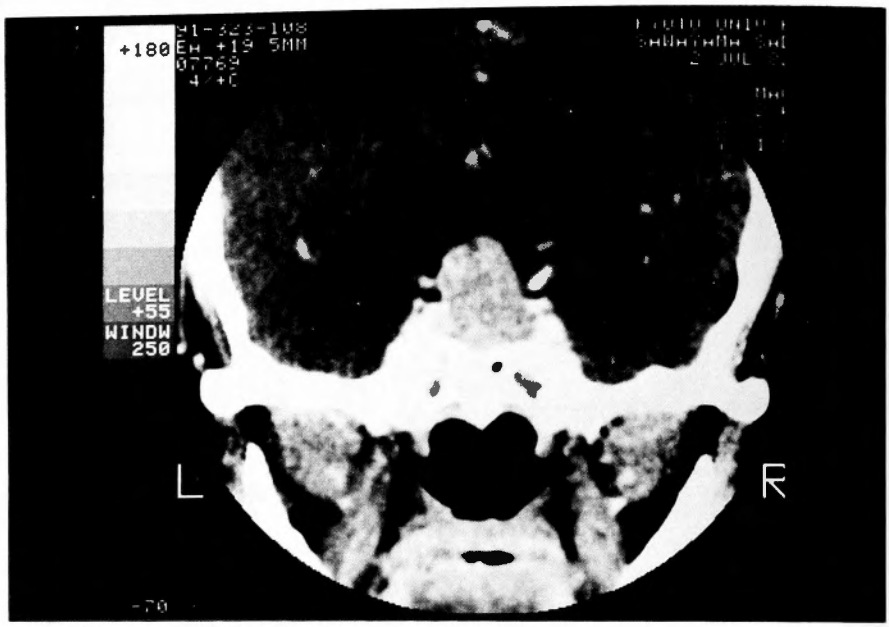

Fig. 4. Case 43: (Prolactin secreting adenoma)
A 43-year-old woman with normal visual field. The height was 13 mm.

In the group of bitemporal hemianopsia, 15 of 17 patients (88%) had a global adenoma with smooth margin.

An adenoma with smooth margin was present in 5 of 8 patients with unilateral visual field defect (62%) and in 11 of 15 patients with normal visual field (73%).

In the group showing atypical field defect, all of them had an adenoma with irregular margin (Table 1).

d) Comparison with tuberculum sellae meningiomas

Table 2. Cases of Tuberculum Sellae Meningioma

Case	Age & Sex	Height (mm)	Width (mm)	Margin	Visual Field
1	60F	17	33	S	
2	45F	10	22	S	
3	51F	13	27	S	
4	64F	18	28	S	
5	57F	15	30	S	
6	47M	11	20	S	

S: Smooth
M: Male
F: Female

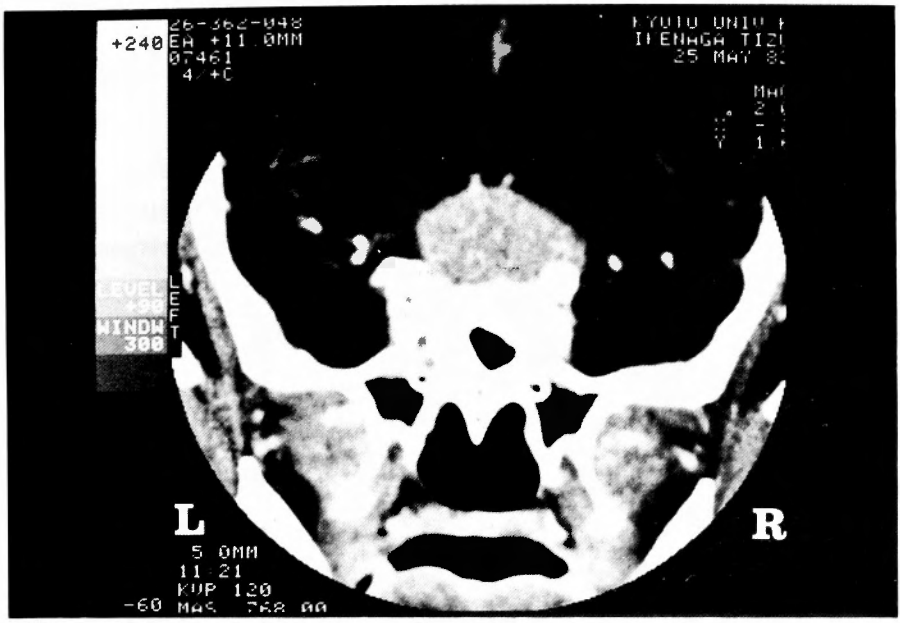

Fig. 5. Tuberculum sellae meningioma Case 1:
A 60-year-old woman with blindness of right eye. Only a very small visual field was remained on the left side. The height of the tumor was 17 mm and the width was 33 mm. The visual disturbance was much more severe in this case than in adenoma cases with the same height.

Medical records of 6 patients with tuberculum sellae meningioma were shown in Table 2. All of these masses were less than 20 mm in the height from the upper surface of the anterior clinoid process to the tumor summit. They showed a higher degree of visual field defects than those with pituitary adenoma (Fig. 5).

Discussion

In the present study, seventeen of 46 patients (37%) showed typical bitemporal hemianopsia. On high resolution CT scan with coronal sections, all but one cases of these 17 patients (94%) beared a large mass more than 20 mm in height, which was defined as the distance from the upper surface of the anterior clinoid process to the tumor summit. And fifteen of them (88%) had a global shaped adenoma with smooth margin.

As compared to the group of typical bitemporal hemianopsia, only one of 8 patients (13%) in the group of unilateral visual defect had a mass more than 20 mm in height, and none of 15 patients in the group of normal visual field. In the group of atypical visual field defect, five of 6 patients (83%) harbored a mass more than 20 mm in height and the width of the mass was much larger than those of other groups. All of these adenomas were irregular in shape. The present results showed that most adenomas with the distance from the upper surface of the anterior clinoid process to the tumor summit more than 20 mm presented bitemporal hemianopsia or atypical field defect, of which a global shaped adenoma had a tendency to give rise to bitemporal hemi-

anopsia and an irregular shaped one did atypical field defect.

The mechanism by which visual field defects are produced by pituitary adenomas is not yet obvious. It has been thought that it is caused by mechanical compression to the optic nerve and chiasm[1,3,5,9,12,14,16,17,21], or by vascular obstruction due to adenomas[1,11,15]. Mechanical compression may be caused by direct effect by the tumor itself and a secondary compression by the bony structure[10,12,16] and the arteries[9,16] such as anterior cerebral artery and/or anterior communicating artery. Sometimes, the development of bitemporal hemianopsia was interpreted to occur in the way that the pressure of tumor upward against the chiasm produced the initial superior temporal defect and that in turn the growing tumor and the chiasmal displacement against the anterior communicating artery caused the subsequent inferior temporal defect[9]. According to the ischemic theory, the inferior temporal defect is interpreted to occur by the obstruction of vessels supplying superomedial part of chiasm[11].

Whether the mechanism is mechanical compression or ischemic effect, it is thought that, when the distance from the upper surface of the anterior clinoid process to the tumor summit on CT scan reaches 20 mm, bitemporal hemianopsia appears in most cases with pituitary adenomas. This "height" may present the extent of upward displacement of chiasm by the mass[20]. This is not true in cases with adenomas extending upward irregularly. They do not cause bitemporal hemianopsia even if adenomas become much larger.

In our series, unilateral visual field defect was frequently seen in patients with a relatively small mass in which the height was less than 20 mm. Although adenomas in the group of unilateral visual field defect were smaller than in the group of bitemporal hemianopsia, they were more irregular in shape. An irregular shaped mass may compress one optic nerve but not the other. Not only the direct compression onto the nerve by tumor itself but also compression against the solid margin of the optic canal[10] may cause unilateral visual deterioration. In the group of atypical field defect, three of them (50%) had a huge adenoma in which the height was more than 40 mm, and all of these three cases were irregular in shape. It is thought that a huge adenoma breaks its capsule before compressing optic nerves, and extends to the extra-capsular space without apparent visual disturbance. Such an adenoma does not show typical bitemporal hemianopsia, but later when an adenoma becomes huge, atypical field defects such as homonymous hemianopsia or concentric constriction may appear.

Six cases with tuberculum sellae meningioma were studied to compare with those with pituitary adenomas. All of them showed more severe defects in their visual field than adenoma patients with the same height. This seems to be due to the difference of location, hardness of the tumor, and the extent of adherence to the chiasm. And when a patient with suprasellar mass with less than 20 mm in height on CT scan shows severe visual disturbance, the mass may be a meningioma but not pituitary adenoma.

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和文抄録

下垂体腺腫におけるCT上の大きさ及び形態と視野狭窄の関係について

京都大学脳神経外科
小島 正行，半田 肇，橋本 信夫，山上 達人

高解像（CT scan の冠状断を用いて，下垂体腺腫46例について，腫瘍の大きさ及び形態と視野狭窄の関係について検討した．両耳側半盲を呈した17例中16例が，前床突起上縁より腫瘍尖端までの高さが 20 mm 以上の腺腫を有していた．非定型的な視野狭窄（同名性半盲，求心性視野狭窄等）を呈した6例中，この高さが20 mm 以上であった症例は5例であり，また全例辺縁不整の腫瘍を有していた．一側性視野狭窄は，この高さが 20 mm 以下で辺縁不整の腫瘍に多く見られ，また視野正常の15例中，20 mm 以上の腺腫を有した例は1例もなかった．

以上より，CT scan における下垂体腺腫の大きさ及び形態と視線狭窄とはよく相関し，CT scan の冠状断は，視野に関して，予後及び治療面で重要なる情報を与えると考える．